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EXAMINER

RAO, SHRINIVAS H

ART UNIT PAPER NUMBER

2814

DATE MAILED: 09/29/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/398,189

Applicant(s)

KANAMORI, JUN

Examiner

Steven H. Rao

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 27 July 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☐ Claim(s) 2-6 and 24-38 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☐ Claim(s) 2-6, 24-38 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 22 July 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

***Response to Amendment***

Applicants' amendment filed on July 17, 2003 has been entered on July 22, 2003.

Therefore claims 2 to 6 and 24-34 as recited in the amendment and claims 35-38 presently newly added by the amendment are currently pending in the Application. Claims 1, and 7-23 were previously cancelled.

***Drawings***

The corrected drawings filed on July 17, 2003 have been accepted by the draftsman.

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 2-6 and 24 to 38 are rejected under 35 U.S.C. 103(a) as being unpatentable over AAPR ( Applicants' Admitted Prior Art), Doan ( U.S. Patent No. 5,946,595, herein after Doan) and Besser et al. ( U.S. Patent No. 6,165,903, herein after Besser) and Xiang ( U.S. Patent No. 6,015,752 , herein after Xiang ) . ( The previous rejection is reproduced below, for response to Applicants' arguments see section below).

With respect to newly added claims 24 and 30, AAPR teaches the method of fabricating a semiconductor device including the steps of :

Providing a silicon substrate (AAPR fig. 1 # 12), providing a buried oxide layer on the silicon substrate (AAPR fig.1 # 14), providing a field oxide layer and a silicon on insulator layer on the buried oxide layer (AAPR # 16 and 18) providing a gate oxide layer on the silicon on insulator layer (AAPR # 20), providing a metal layer ( i.e. poly-silicon gate layer) on the gate oxide layer ( AAPR # 22), providing a gate sidewall layer on the silicon on insulator layer to surround the poly-silicon gate layer and the gate oxide layer ( AAPR # 24), providing a material to be silicided on a surface of the semiconductor device including the poly silicon gate layer, the gate sidewall layer, the silicon on insulator layer and the field oxide layer ( AAPR fig. 1B and C ultimately forming layer 32), performing a first rapid thermal annealing process to form first-reacted silicide regions in the poly-silicon gate layer and in source/drain active areas of the silicon on insulator layer (AAPR Applicants' specification –prior art section page 2 lines 9-14), removing non-reacted material from the first –reacted silicide regions (AAPR specification –prior art section page 2 lines 13-15 ).

AAPR does not specifically describe providing a supplemental silicon layer over the surface of the semiconductor device after the non-reacted material is removed.

However, Besser, a patent from the same filed of invention, describes in fig. 8 layer # 46 and col. 5 lines 25-40 a supplemental silicon layer to convert the first reacted silicide region into a second reacted silicide region and to prevent junction leakage problem.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to include Besser's second supplemental silicon layer in AAPR's method steps to prevent junction leakage problem. ( Besser col. 5 lines 65-col. 6 line 5).

AAPR and Besser do not specifically describe doping the supplemental silicon layer.

However, Doan, a patent from the same filed of endeavor, describes in fig. 8 and col. 6 lines 7-17 the doping of the supplemental silicon layer so that it can etched at a faster rate in comparison with the layers below it.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to include Doan's doping of the supplemental silicon layer step in AAPR , Besser's method to provide a doped layer that etches differently from the layers underlying it. (Doan col. 6 lines 31-37).

The supplemental silicon region preventing the poly-silicon gate layer and the silicon on insulator layer from being completely silicided ( Doan col. 6 lines 36-39 and further as Doan and the instant application use the same materials in similar method steps for the same purpose what is true for applicants is also true for Doan).

"The semiconductor device including a p-channel MOS transistor having a p-type source and drain regions, and including an n-channel MOS transistor having n-type source and drains. "

AAPR, Besser and Doan do not specifically describe a CMOS device .

However, Xiang, col. 3 line 47, col.5 line 59-60 was cited to show that by definition (and as is well known to one of ordinary skill in the art ) CMOS includes both

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n-channel transistor having n-type source and drain regions and p-channel transistors having p-type source and drain regions.

"Said doping comprising doping a p-type impurity into the supplemental silicon that is provided over the p-channel MOS transistor and doping an n-type impurity into the supplemental silicon layer that is provided over the n-channel Mos transistor. "

Further a p-type source/drain with a thin polysilicon strap ( as shown in Doan i.e the supplemental silicon layer ) would obviously have to be doped p-type to form an excellent ohmic contact and avoidance of a P-N diode formation and similarly for N-type source/drain region the connecting strap ( the thin poly silicon strap, i.e. supplemental silicon layer) would be doped N-type for the same reasons.

With respect to claims 2 and 3 wherein the material is cobalt or titanium ( AAPR page 26 last two lines).

With respect to claim 4, wherein the polysilicon layer is formed by CVD ( well known in the art).

With respect to claims 5 and 6 wherein the supplemental silicon layer is a  $\text{Si}$  (amorphous silicon) formed by sputtering ( Bresser col. 1 lines 34-36, col. 5 lines 35-40) and selectively removing non-reacted silicon from the second- reacted silicide region after the second rapid thermal annealing . ( AAPR teaches a method of making a semiconductor device by a self aligned silicide process, including selectively removing non reacted silicon after RTA, the un reacted silicon will be removed during the wet etch and removing the un reacted silicon after first RTA as stated in the back ground art is not patentably distinct from removing it after second RTA).

Claims 25-29 repeat the steps of claims 2-6 above and are rejected for reasons stated under respective claims above.

With respect to claims 31 to 34 , wherein the doping comprises of doping a p-type ( n-type) impurity into the supplemental silicon layer so that only the supplemental silicon layer over the p-channel ( n-channel) MOS transistor is doped p-type (n-type). ( as shown in Doan i.e the supplemental silicon layer ) would obviously have to be doped p-type to form an excellent ohmic contact and avoidance of a P-N diode formation and similarly for N-type source/drain region the connecting strap ( the thin poly silicon strap, i.e. supplemental silicon layer) would be doped N-type for the same reasons) .

Presently newly added claims 35-38 are rejected for the following reasons :

With respect to claims 35 and 37 wherein the thickness of the silicon region is in a range of 50-100 nm. ( Besser col. 5 lines 30-35, specification page 2 last paragraph).

With respect to claims 36 and 38 wherein the thickness of the silicon region /on insulator is less than 70 nm ( Besser col. 5 lines 30-35, specification page 2 last paragraph).

It is noted that the specification contains no disclosure of either the critical nature of the claimed dimensions of any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another value recited in the claim, the Applicant must show the chosen dimensions are critical. In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ 2d 1934, 1936 ( Fed. Cir. 1990).

### ***Response to Arguments***

Applicant's arguments filed 07/22/03 have been fully considered but they are not persuasive because Firstly Applicants' analysis is based on impermissible piecemeal attacks on the references, Applicants' arguments do not address the rejection based on the combined teachings of the references Applied.

Applicants' argument that a supplemental layer is not described by AAPR is noted and as stated on page 4 of the last Office Action mailed on April 17, 2003 Besser describes in fig. 8 layer # 46 and col. 5 lines 25-40 a supplemental silicon layer and the combination of AAPR and Besser teaches the supplemental layer.

Applicants' next argument that the Besser reference is silent about a SOI structure is not persuasive because Besser in col. 6 lines 22 to 25 states :

metal in forming the silicide. However, the present invention finds utility in other applications employing other materials in which a monosilicide is transferred to a disilicide, where silicon is the diffusing species.

Therefore Besser 's description is equally applicable to other devices including SOI devices because Besser describes using silicon only from the supplemental layer (layer 46) as the diffusion species during the second annealing step to from lower resistivity metal silicide regions without using any silicon as the diffusion species from substrate 30 thus achieving the same effect as SOI namely avoid using any silicon as the diffusion species from substrate and therefore avoid problems like electrical leakage, etc. AAPR achieves the same result for the same purpose by using a SOI structure instead of regular substrate and therefore the combination of AAPR ( teaching SOI) and Besser teach an SOI structure using silicon only from the supplemental layer



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as the diffusion species during the second annealing step to from lower resistivity metal silicide regions without using any silicon as the diffusion species from the substrate.

Further the well known semiconductor devices like SOI is used ( including in Besser's methods) when it is important to control stress during subsequent processing steps and is also an important junction isolation technique not suitable for high voltage applications e.g. + 30 volts, therefore full isolation i.e. completely surrounding devices with an insulator that provides the full isolation needed referred to as silicon on insulator or S-O-I.

It is noted that Besser teaches silicide layers using RTA with supplemental layer to avoid forming voids in the substrate.

**THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Steven H. Rao whose telephone number is (703) 3065945. The examiner can normally be reached on 8.00 to 5.00.

The fax phone numbers for the organization where this application or proceeding is assigned are (703) 7463926 for regular communications and (703) 872-9319 for After Final communications.

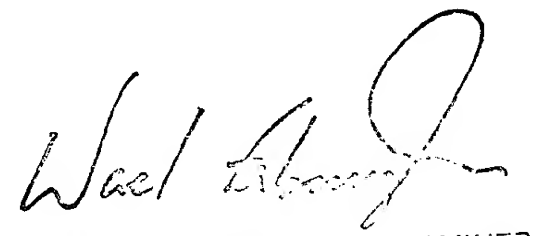
Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 3067722.



Steven H. Rao

Patent Examiner

September 25, 2003



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